REMARKS

Claims 1-3, 11-12 and 19-21 are presently pending in the application.

In accordance with Rule 121(c) pertaining to the amendment of claims, the Appendix submitted herewith contains a Marked-Up Version of claims 1 and 12 showing the changes made by this Amendment with underlining showing additions and brackets showing deletions.

Claims 1 and 12 have been amended in view of the Examiner's §112 rejection of claims 1-3 and 12 based on the absence of a substrate, as set forth in Paper No. 7. Specifically, claims 1 and 12 have been amended to positively recite a substrate. Support for this amendment can be found in the specification, at least at page 11, line 14 to page 14, line 4 and in the Examples. No new matter has been added by these amendments and applicants respectfully request reconsideration and withdrawal of the rejections of claims 1-3 and 12 under 35 U.S.C. § 112.

The applicants are pleased to acknowledge the Examiner's withdrawal of the § 112 rejection of claims 1-3, 12 and 20 as well as the Examiner's withdrawal of the obviousness combination rejection based on U.S. Patent No. 5,728,456 of Adair, *et al.* ("Adair") and Ozer.

However, the Examiner has now rejected claims 1, 12 and 20 under 35 U.S.C. § 102(b) as being anticipated by Adair. The Examiner has also rejected claims 2-3, 11-12, 19 and 21 under 35 U.S.C. § 103(a) as being unpatentable over Adair.

Applicants respectfully but strenuously traverse these rejections and the arguments in support thereof, and request reconsideration and withdrawal for the reasons set forth below.

Rejection Under 35 U.S.C. § 102(b) Based on Adair

The Examiner argues that Adair discloses an antireflection coating with a layer of refractive index higher than 1.8 or 2.0 made of materials such as titanium oxide, zirconium oxide, and niobium oxide, among others. The coating is allegedly intended for use on a plastic or glass substrate, which are argued to be known to have melting points higher than 100 °C. The Examiner further argues that absent a showing that there is a material or unobvious difference between the claimed product and that of the prior art, the process limitations do not create a patentable distinction.

For a claim to be rejected as anticipated under 35 U.S.C. § 102(b), it must be shown that the cited prior art reference alone teaches or suggests all of the claimed elements. (M.P.E.P. § 2131).

Adair teaches absorbing antireflection coatings which exhibit optical properties characterized by large bandwidths, and which are stated to be simple and cost effective to produce (col. 6, lines 29-34). The two-layer coatings of Adair comprise: (1) an outer thin layer of transparent material having a low refractive index (between 1.30 and 2.0), which is preferably SiO_2; and (2) a very thin inner layer having a high index of refraction (greater than 1.8) made of an absorbing, electrically conductive, transition metal oxynitride material (col. 8, lines 36-44). More specifically, Adair teaches that the inner layer comprises a transition metal combined with non-stoichiometric quantities of both nitrogen and oxygen. Although titanium is the preferred transition metal, other transition metals known to form oxynitrides can also be used, including, among others, niobium (col. 9, lines 51-54 and 65-67).

Adair does not teach, as the Examiner contends, that the high refractive index layer in Adair's invention can be made of materials including niobium oxide. Adair also does not teach or suggest that niobium oxide alone is applicable as a sol-gel derived high index of refraction layer having a refractive index of at least 1.9. The coating of Adair is based on transition metal oxy*nitrides* and niobium is taught to be only one possible transition metal which can be utilized. However, both of the Examples of Adair utilize titanium, the preferred transition metal. Furthermore, Adair is not directed to teaching the use of Nb_2O_5 itself as a high refractive index material. Instead, Adair merely teaches, in the background section, that antireflective coatings comprising multiple layers of at least two different materials, including Nb_2O_5, are known in the art.

Applicants' invention is also not directed merely to niobium oxide as a new high refractive index material. In fact, it is disclosed in the background section of the present specification that niobium oxide has been used to produce a high index of refraction layer in thin film optical coatings through expensive sputtering and chemical vapor deposition techniques (page 3, lines 26 to page 4, line 2). Applicants' invention is materially different than that taught by Adair because applicants' niobium oxide film formed by sol-gel techniques is curable at temperatures below 150° C, which are low enough for use on plastic substrates, while still maintaining a refractive index greater than about 1.90. Applicants have found that by producing the films by sol-gel techniques, such properties can be obtained. Previously, sol-gel derived high refractive index niobium oxide layers were not known (specification page 4, lines 25-26). Since applicants' coating can be cured at low temperatures, it is thus useful for coating on low-melting point substrates such as plastic substrates while still maintaining a high enough refractive index to be used as an "H" layer in a multilayer antireflection coating. For these reasons, there is a material and patentable distinction between the present invention and that of Adair.

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The deposition method taught by Adair is in-line magnetron sputtering (col. 13, lines 25-27). Although such a method is known to be applicable for coating various substrates, magnetron sputtering is an expensive process and is highly uneconomical. Applicants have discovered in the present invention a sol-gel derived layer which can be cured at low enough temperatures for use on plastics. This sol-gel derived niobium oxide layer forms the basis for applicants' invention. As discussed herein, even if Adair did teach or suggest a niobium oxide high refractive index layer, there is a material difference between the claimed layers prepared by sol-gel techniques and those in the prior art prepared by alternative methods. Therefore, Adair does not teach or suggest all elements of the present claims.

Regarding claim 12, Adair teaches that Al_2O_3 and SiO_2 may be used in the outermost, or low refractive index layer, of the two layer coating (column 9, lines 28-40). On the other hand, the transition metal niobium is only mentioned in relation to the innermost, high refractive index layer, and then only when used in a transition metal oxynitride (column 9, lines 51 to column 10, line 2). As discussed above, Adair does not teach Nb_2O_5 layers. In addition, Adair does not teach or suggest a combination of Nb_2O_5, SiO_2, and Al_2O_3 in the same layer to have a medium index refraction of about 1.60 to about 1.90 as recited in the present claim.

Finally, claim 20 recites an optical filter prepared using sol-gel technology. For several reasons, Adair does not teach or suggest all elements of the claim. First, Adair does not teach or suggest an optical filter. Second, the method of producing the layer by sol-gel techniques described in the claim is not taught by Adair. Rather, Adair describes the production of coatings by in-line magnetron sputtering, which is taught by Adair to be the preferred method for deposition of the coating layers. Adair does not teach sol-gel techniques as described in the method steps in claim 20, including an optical filter formed by immersing a substrate, withdrawing the substrate, and heat treating the substrate to form an optical filter as claimed.

While the Examiner argues that the process limitations are without patentable significance absent a difference in the articles claimed, the Examiner does not take into account the fact that the method of depositing coating layers on a substrate has an effect on the refractive index of the resulting layer. For example, although high refractive index niobium oxide layers produced by sputtering or chemical vapor deposition are known, niobium oxide layers produced by prior sol-gel technology techniques did not provide high refractive indices. The refractive index of a particular coating layer is dependent on both the nature of the material being used to form the coating and the method of production. Additionally, the cost of producing a layer and the viability of making such a layer in a practical manner is determined by the method of deposition. Whereas

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magnetron sputtering, like other electronic deposition or sputtering techniques, requires expensive equipment and high processing costs which render it impractical for significant production, the sol-gel process is inexpensive, economically viable, and therefore more useful for practical commercial manufacture. Consequently, applicants' invention provides a low cost method of producing niobium oxide coating layers which have a sufficiently high refractive index (≥ 1.90) to be used as an "H" layer in an antireflection coating which was heretofore not possible using sol-gel techniques. This low cost, high refractive index niobium oxide material exhibits material differences compared with the prior art material of Adair that is not taught to be cured at temperatures below 150° C and thus would be applicable for use on substrates such as plastics while maintaining a refractive index of at least about 1.90. Therefore, there is a patentable distinction between the claimed invention and the prior art.

For all of these reasons, Adair does not teach or suggest all elements of claims 1, 12 and 20. Reconsideration and withdrawal of the § 102(b) rejection is respectfully requested.

Rejection Under 35 U.S.C. § 103(a) Based on Adair

Regarding claims 2, 11, 12 and 19, the Examiner argues that Adair fails to disclose the exact temperature ranges for the substrate. However, the Examiner concludes that because overlapping ranges are *prima facie* evidence of obviousness, it would have been obvious to one having ordinary skill in the art to have selected the portion of the temperature range that corresponds to the claimed range. Regarding claims 3 and 21, the Examiner acknowledges that Adair is silent about the use of a mixed oxide or its composition. However, the Examiner argues that it is known in the art to use a mixture of materials to adjust the index of refraction. Therefore, the Examiner concludes that it would have been obvious to one having ordinary skill in the art at the time of the invention to include silicon oxide or aluminum oxide in Adair's layer since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of design choice.

When making a rejection under 35 U.S.C. § 103(a), the Examiner has the burden of establishing a prima facie case of obviousness. In order to establish *prima facie* obviousness, the Examiner must make all of the following showings: (1) there must be some suggestion or motivation to modify the reference as suggested by the Examiner (it is not sufficient to say that the cited reference can be modified without a teaching in the prior art to suggest the desirability of the modification); (2) there must also be a reasonable expectation of success; and (3) the reference must teach or suggest all limitations of the claims. The teaching or suggestion to modify the applied art

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and the reasonable expectation of success must be found in the cited prior art and not in the applicants' specification (MPEP § 2143).

Claim 2 recites that the sol-gel derived niobium oxide layer is low-temperature cured. As discussed previously, Adair does not even teach a sol-gel derived niobium oxide layer, and only mentions niobium oxide in the background section of the specification. Furthermore, the layers of Adair are applied by in-line magnetron sputtering and thus are not cured. Adair does not recite any temperature at which such layers are applied to a substrate. Therefore, applicants respectfully submit that the Examiner's argument concerning overlapping ranges does not apply to this claim, as no temperature range is taught by the prior art. Since Adair does not teach or suggest all of the claimed elements, no *prima facie* case of obviousness has been established, and withdrawal of the § 103(a) rejection is respectfully requested.

Similarly, regarding claim 12, the same argument applies and the Examiner's rejection based on overlapping ranges being *prima facie* evidence of obviousness is moot. Withdrawal of the § 103(a) rejection of claim 12 is respectfully requested.

Regarding claims 11 and 19, which recite the melting point of the substrate on which the sol-gel derived niobium oxide coating is applied, applicants are not attempting to patent a substrate with a particular melting point. The temperature that a substrate can withstand is a physical characteristic of the material from which it is formed, and the purpose of applicants' invention is not to select substrates with particular melting points. Rather, applicants have invented a sol-gel derived niobium oxide coating which can be applied on substrates with melting points less than or equal to about 450 °C, including plastic substrates, while maintaining the high refractive index of the niobium oxide layer. What is novel about applicants' invention is that the layers are sol-gel derived and thus are inexpensive to produce, but exhibit high refractive indices. Adair does not teach the aspects of claims 11 and 19 such as the sol-gel derived niobium oxide coating or the coating comprising niobium oxide, silicon dioxide, and aluminum oxide. Consequently, regardless of the melting temperature of the substrate, Adair does not teach or suggest all elements of applicants' claimed invention.

Regarding the rejection of claims 3 and 21, the Examiner argues that it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of design. Applicants are not arguing that it is not known that silicon oxide and aluminum oxide, among numerous other compounds, may be used in layers for coating substrates. However, it is not obvious that the combination of one or more of these oxides with sol-gel derived niobium oxide would result in a layer with a refractive index of at least

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about 1.90 or 1.60 to 1.90, depending on the relative proportions of the different oxides in the coating. There is no suggestion in the cited art to so modify Adair to achieve applicants' claimed invention.

Furthermore, there is no reasonable expectation of success in the modification proposed by the Examiner. Specifically, it is not obvious that such a combination of oxides would result in a layer which would maintain the high refractive index of the sol-gel derived niobium oxide because, as disclosed in the present specification, sol-gel derived, high refractive index niobium oxide were not previously known. As discussed above, Adair only teaches Nb_2O_5 as background information, teaches niobium in the inner layer as an oxynitride, and teaches SiO_2 and Al_2O_3 in the outer layer. Adair does not teach or suggest that a combination of all of these oxides in the same layer would yield low-cost, sol-gel derived layers with the refractive indices recited in the present claims

For all of the above reasons, the Examiner has not established a *prima facie* case of obviousness.

Even if a case of *prima facie* obviousness had been established, which, for the reasons outlined above it has not, applicants' invention solves a long-felt need in the art and demonstrates unexpected results which overcome such a case of obviousness. Applicants' invention is directed to a thin film optical coating which can be deposited on low-temperature substrates such as plastic or other substrates like glass, in which the niobium oxide layer is sol-gel derived and can produce a refractive index of at least 1.90 and preferably at least 2.0. The invention fulfills a long-felt need in the art for a durable material which can be used as a layer having a high index of refraction in a thin film optical coating, and which is inexpensive to prepare in comparison with costly sputtering techniques so as to render it useful for large scale commercial production. Furthermore, the invention fulfills the need for providing such a high refractive index layer on a heat sensitive material such as a plastic because the layers can be produced by low temperature curing. It would not be anticipated based on the cited prior art that the sol-gel derived niobium oxide layers would exhibit such high refractive indices, because, as disclosed in the specification at page 4, lines 25-26, "sol-gel niobium oxide materials are not known to have high indices of refraction." This invention further fulfills a need for providing such a high refractive index layer, which could be used as an "H" layer in an antireflection coating, that is economically feasible to produce due to the low cost of the sol-gel process.

In summary, applicants' invention provides a low cost, sol-gel derived niobium oxide layer with high refractive index, and applicants have shown that the use of low temperature

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curing even allows such layers to be prepared on low-melting substrates such as plastic substrates while maintaining the high refractive index values. None of these properties would be expected based on the prior art references.

For all of the above reasons, applicants respectfully request withdrawal of the §103(a) rejection of claims 2-3, 11, 12, 19 and 21.

In view of the foregoing amendment and remarks, applicants respectfully submit that the pending claims are patentably distinct from the cited prior art of record and in condition for allowance. A Notice of Allowance is respectfully requested.

Respectfully submitted,

NANNING J. ARFSTEN, ***et al.***

____________________ By: ______________________________

(Date)

LYNDA L. CALDERONE
Registration No. 25,918
AKIN, GUMP, STRAUSS, HAUER & FELD, L.L.P.
One Commerce Square
2005 Market Street - 22nd Floor
Philadelphia, PA 19103-7086
Telephone: (215) 965-1200
Direct Dial: (215) 965-1272
Facsimile: (215) 965-1210
E-Mail: lcalderone@akingump.com

SMK/LLC:smk/ccr
Enclosure: Appendix: Marked Up Version of Claims 1 and 12

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Appendix: Marked-Up Version Of Claims 1 and 12

--1. (Twice amended) A coated substrate having a thin film optical coating [for use on a substrate], the coating having a layer comprising sol-gel derived niobium oxide, wherein the layer is capable of providing an index of refraction of at least about 1.90.

12. (Twice amended) A coated substrate having a thin film optical coating [for use on a substrate], the coating having a layer comprising a sol-gel derived oxide system, the sol-gel derived oxide system comprising niobium oxide, silicon dioxide and aluminum oxide, wherein the layer is capable of providing an index of refraction of from about 1.60 to about 1.90.--

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